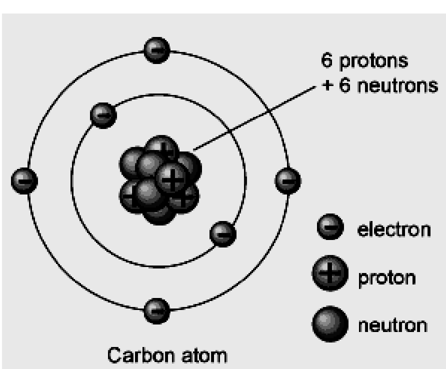




Unit 1
Matter and its construction

Lesson 1 :
Matter and its characteristics
Lesson 2:
Matter construction
Lesson 3:
Atomic structure of matter









Lesson 1: Matter and its characteristics

✓ *Matter*

a- Everything in the universe that you can see is made up of some type of matter

b- Matter is everything that has mass and volume.

c- The space taken by an object is known as volume.

d-The volume of liquids is measured with a graduated cylinder. The units of volume are cm^3 & L .

e- Mass is measured by using a balance.

f- Mass is the amount of matter in an object.

g-The units of mass are grams (g) & kilograms (kg).

✓ *Physical properties*

- You use physical properties such as color ,taste ,smell &volume every day.
  For example: odor (smell) helps you distinguish between water & vinegar.
  Color helps you to distinguish between oil & water.
- Physical property is a characteristic of a substance that you observe or measure without changing the matter's identity.
- **Color, taste & smell are physical properties which can distinguish between materials**.

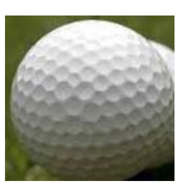
✓ *Density*

- **Density is the ratio of the mass of a substance to the volume of the substance.**

Density is the mass of a unit volume (1 cm^3)

- A tennis ball & a golf ball have the same volume. A golf ball has more mass than a tennis ball does, so the golf ball has a greater density.

- A golf ball is denser because the golf ball contains more matter in a similar volume.



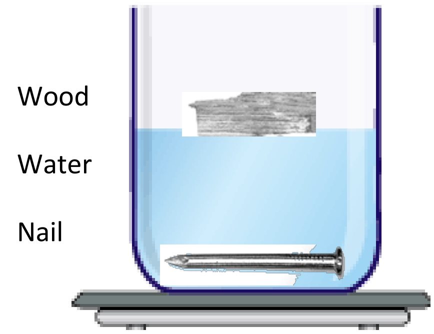


The mass of a tennis ball = 2 g **The mass of a golf ball = 46g**

Activity 1:

Put a nail, a piece of wood, cork , candle ,some oil & an ice cube in a beaker of water.

Observation :



a. The nail sinks in the water.

b. Ice, wood , cork & oil float on the surface of water.

Conclusion:

a. The nail is denser than water, therefore it sinks.

b. Ice, wood, cork , oil & candle are less dense than water & therefore they float.

Density is calculated by the rule: $\text{Density} = \frac{\text{Mass}}{\text{Volume}}$

	Mass	Volume	Density
Unit	g	cm^3	g/cm^3

A solved example:

An object's mass was measured in the lab. & found to be 50g.

The volume was measured using a graduated cylinder & found to be 25 cm^3.

Can you find through calculations if this object floats or sinks in water ?
The density of water is $1 g/cm^3$.

Solution:

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

$$= \frac{\mathbf{50\ g}}{\mathbf{25\ cm^3}} = 2\ g/cm^3$$

The density of this object is bigger than the density of water therefore it sinks in water.

Activity 2:

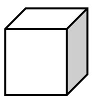
purpose: Explain why similar volumes of different materials have different masses.

Steps:

1. You're given equal volumes of three materials iron, water & oil.
2. Measure each mass using a balance.
3. Calculate the density of each substance.

Observation: The masses of water , oil & iron are different.

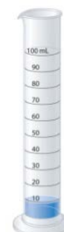
Conclusion: Different materials which have similar volumes , have different masses. because they have different densities.



1 cm^3 of iron
Mass = 7.87g
Density = 7.87 g/cm^3



1 cm^3 of water
Mass = 1g
Density = 1 g/cm^3



1 cm^3 of oil
Mass = 0.82g
Density = 0.82 g/cm^3

Use the concept of density to give reasons for the following:

1. **Balloons filled with helium rise upwards.**

That's because the density of helium is less than that of air.

2. **Burning oil & flaming petroleum oil aren't extinguished with water.**

The density of oil is lower than water, therefore oil floats on top of water where it is exposed to air & keeps burning.



✓ *Alloys:*

In industry, metals are molten & mixed together to improve their characteristics & use them in daily life.

An alloy is a mixture of 2 metals or more to improve their characteristics.

Examples of alloys & their uses in daily life:

Gold & copper alloy used in making jewelry.



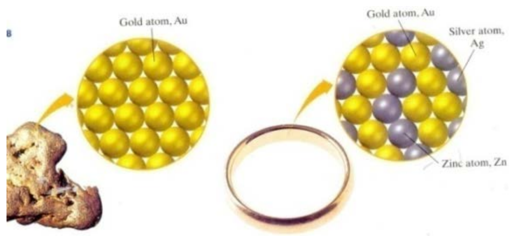
Nickel chrome (nichrome) alloy used in making the heating coils of electric heaters & boilers.





Enriching information

a- The gold nugget is pure gold which is too soft for jewelry.



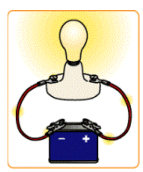
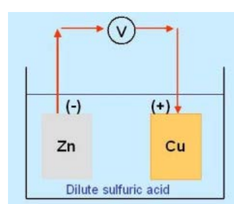
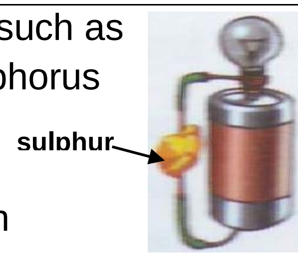
b. This ring is 58.3%, gold & 41.7% copper. This alloy of gold & copper is stronger than pure gold and is often used for jewelry

- Nichrome is an alloy of nickel & chromium. It doesn't rust & it has a high melting point therefore it is used in electric heating elements , such as in electric ovens & boilers.

✓ *Electric conduction:*

Electricity can pass through certain materials such as metals, but it can't pass through other materials such as non – metals.

Materials are classified into good electric conductors & bad electric conductors.

	Good electric conductors	*Bad electric conductors*
Definition	They allow electricity to pass through them.	They don't allow electricity to pass through them.
Examples	1-Metals such as copper & silver.  2-Some acids, alkalis or salt solutions 	1-Non – metals such as sulphur & phosphorus  2-Sugar solution 3-Hydrogen chloride solution in benzene 4-wood & plastic.
Uses	Electric cables are made from copper. Electric screwdrivers are made from steel. 	• Handles of electric screwdrivers are made of wood or plastic. • Electric wires are covered with plastic insulators.

Give Reasons for the following:



Electric cables are made from copper & covered with plastic.

Answer: Copper is a good electric conductor while plastic is an insulator which prevents electric shocks.

✓ *Thermal conduction :*

- Heat passes through certain materials well, while other materials don't allow heat to pass through them.
- Materials are classified according to thermal conductivity into good thermal conductors & bad thermal conductors.

	Good thermal conductors	*Bad thermal conductors*
Definition	They allow heat to pass through them.	They don't allow heat to pass through them.
Examples	Metals such as copper, aluminium & iron.	Wood & plastic.
Uses	Aluminum is used in making cooking pots.	Wood & plastic are used in making handles of cooking pots.

✓ *Give Reasons for the following:*

Cooking pots are made from aluminium & their handles are made from wood or plastic.

Answer: Aluminium is a good thermal conductor while wood & plastic are bad thermal conductors therefore they don't allow transfer of heat to your hand.

✓ *Chemical properties*

- Chemical properties describe the ability of matter to change into a new substance with different properties.
- Burning paper & coal are examples of chemical reactions we see in daily life.
- Reactivity is the ability of two or more substances to combine & form a new substance.

Examples of reactivity:

Rusting of metals:

Many metals such as iron when exposed to humid air (rich in water vapour) for some time, react with oxygen & water forming rust which changes the color & properties of the metal.





✓ *Metals vary in their ability to react with oxygen.*

The reactivity with water	High (active)	Intermediate	Low (inactive)
Examples	Sodium – Potassium	Iron – aluminium – copper	Gold– silver– platinum
			Used in jewelry 

✓ *Give Reasosns for the following:*
Metallic parts of bridges, cars & light posts are painted periodically.
The paint prevents the reaction between the metal & water & oxygen protecting the metal against rust.



Metal rust





The bridge workers are coating it with paint

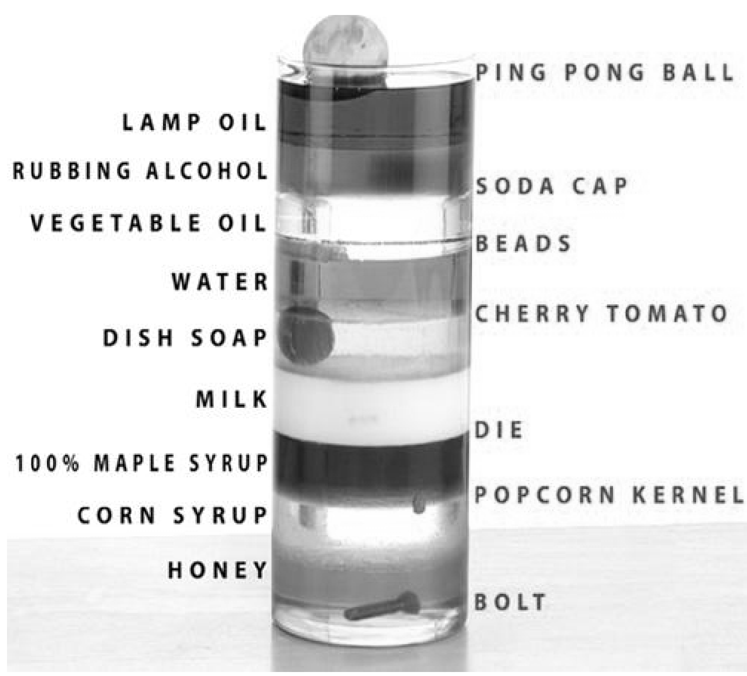
Summary & important definitions

- ✓ **Matter** is everything that has mass & volume.
- ✓ You use physical properties such as color, taste & smell to identify matter.
- ✓ **Density** is the ratio of the mass of a substance to its volume.
- ✓ Density = mass / volume.
- ✓ The units of mass are g & kg.
- ✓ The units of volume are cm^3& L.
- ✓ The unit of density is g/cm^3.

- ✓ Substances denser than water sink in water & those less dense than water float on the surface of water.
- ✓ Oil fires aren't extinguished with water because oil floats on water & keeps in contact with air & keeps burning.
- ✓ **An alloy** is a mixture of metals to improve their properties.
- ✓ Jewelry is made of gold & copper alloys.
- ✓ Nichrome alloy is used in making heating coils of electric heaters.
- ✓ An electric conductor is a material in which electricity moves freely. Wires are made from copper, a good electric conductor.
- ✓ An electric insulator is a material in which electricity can't pass. The handle of an electric screwdriver is made of plastic, an electric insulator.
- ✓ Electric conductors such as metals , acids , alkali & salt solutions have many uses.
- ✓ Non – metals , sugar solution , wood & plastic are bad electric conductors.
- ✓ Wood & plastic are used as insulators.
- ✓ Metals are also good thermal conductors & are used in making cooking pots.
- ✓ Wood & plastic are bad thermal conductors & therefore they are used in making the handles of cooking pots.
- ✓ Sodium & potassium are highly reactive with water & oxygen.
- ✓ Iron, aluminium & copper have intermediate reactivity with water & oxygen.
- ✓ Gold, silver & platinum don't react with water or oxygen , therefore they're used in making jewelry.
- ✓ Metallic bridges, cars & light posts are painted to prevent the reaction with water & oxygen & prevent their rust & decay.

Enriching Activity

Liquids are arranged in multi- layers according to their densities



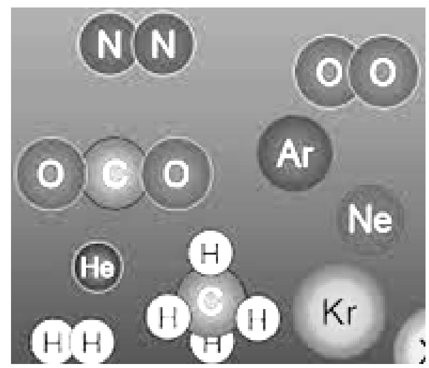
Lesson 2: Matter Construction

Carry out the following activity to learn the structure of matter.

Open a bottle of perfume. The smell of the perfume spreads in the room.

You can explain this observation by saying that the perfume consists of tiny particles that carry the smell of the perfume. These tiny particles are called molecules.

Definition of the molecule: It is the smallest particle of matter that exists freely & carries the properties of the substance.



All types of matter are made of molecules. The molecules of water are all similar . All the molecules of oxygen are similar.
The molecules of water are different from the molecules of oxygen.

Activity 1:



Purpose : To observe the motion of the molecules

With a dropper , put a drop of liquid colour in a beaker of water.

Observation: The color spreads in the water

Conclusion : Molecules are in continuous motion.

Activity 2:

Measure 50 ml of water with a graduated cylinder.
Measure 50 ml of vinegar then pour it in the cylinder that contains water.

Observation: The volume of water & vinegar is less than 100 ml

Conclusion : Some vinegar molecules occupy the spaces between water molecules.



- The spaces between the molecules are called **intermolecular spaces.**
- **Attraction forces** keep molecules together.

✓ *States of matter:*

Matter exists in three states : solid , liquid & gas.

Water exists as solid ice , liquid water or gas as water vapour.

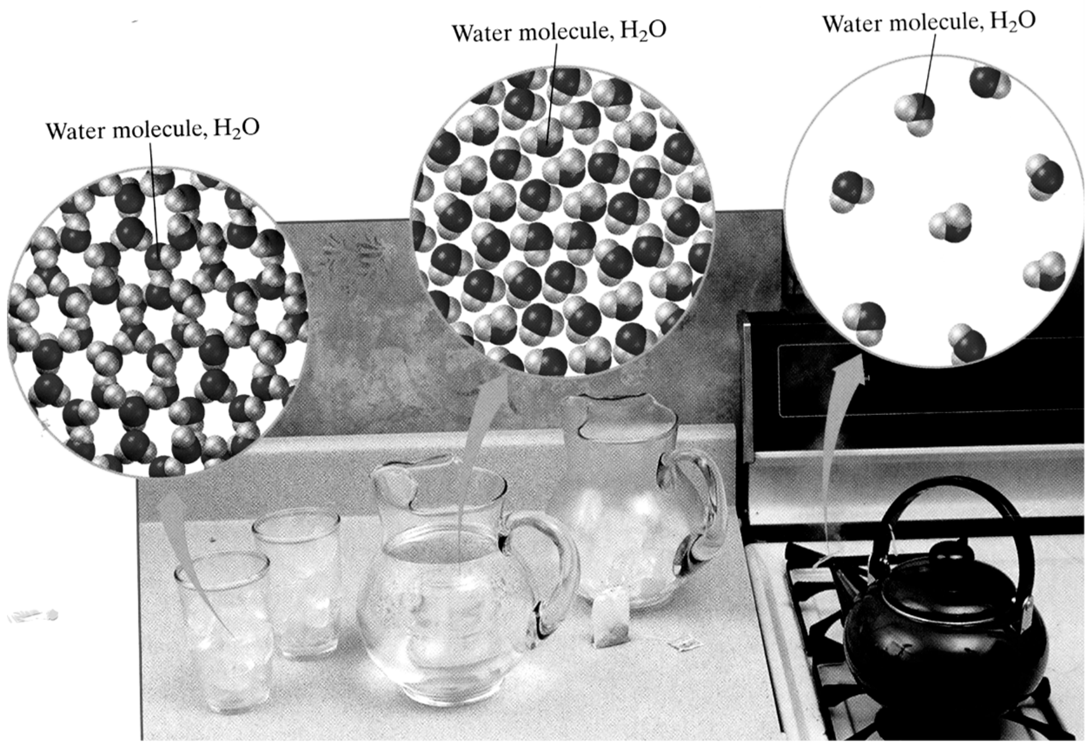
Matter can change from one state to another by heating or cooling.

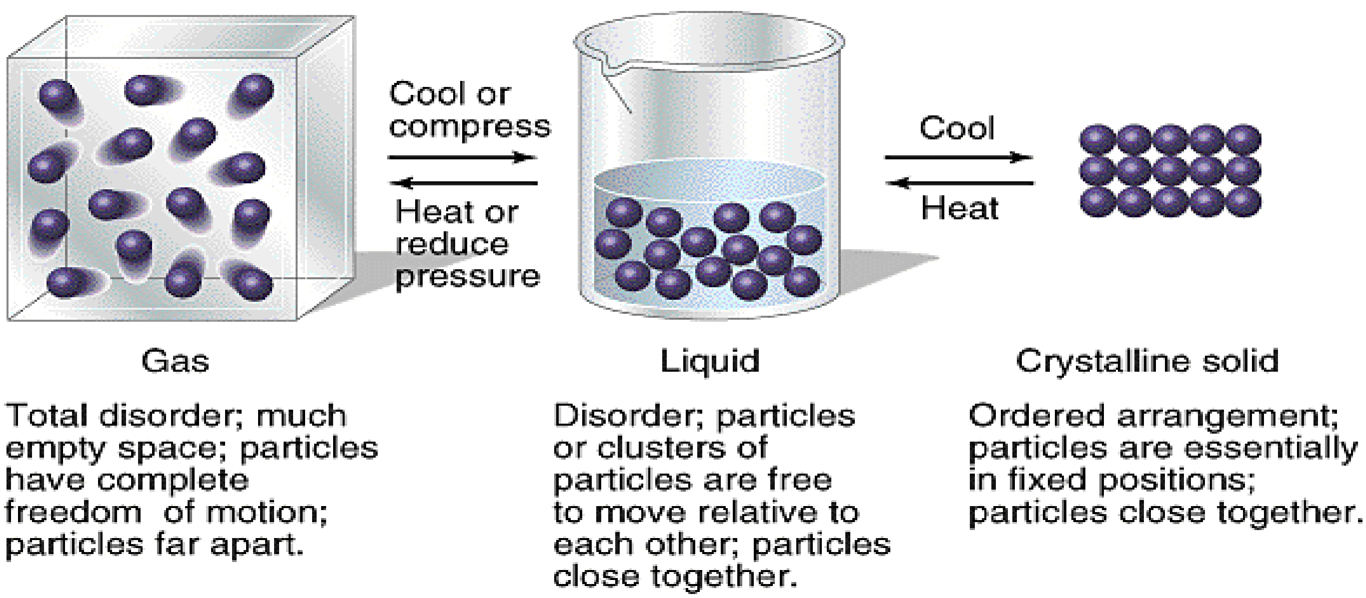
Below 0°C , water exists as ice. Particles in a solid vibrate in place.

Between 0°C & 100°C , water exists as a liquid. Particles can move past one another.

Above 100°C , water is a gas.

Molecules in a gas move freely over large distances.





✓ *Comparison between the 3 states of matter.*

Points of comparison	*Gaseous state*	*Liquid state*	*Solid state*
Volume	Not definite	Definite	
Shape	Not Definite, they take the shape of their containers		Definite
Examples	Water vapour, oxygen, carbon dioxide	Water, alcohol, oil	Ice , iron , aluminiumm.
Intermolecular forces	Don't exist	Weaker than solids	Very strong
intermolecular spaces	Very large	Bigger than solids but smaller than gases	Tiny
Motion of molecules	Completely free	free	Limited

✓ *Melting & melting points:*

- ❖ **Melting** is the change of solid substance into liquid substance.
- ❖ The temperature at which the substance starts melting is the **melting point**.



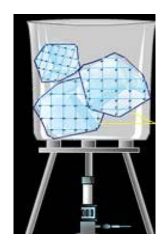


- ❖ Melting needs heat to occur.
- ❖ Metals such as iron, copper & aluminium have high melting points.
- ❖ Ice, wax & butter have low melting points.

✓ *Give Reasons for the following:*

1. A solid substance such as ice melts when heated above its melting point.

Answer: The molecules gain energy & move apart. Intermolecular spaces increase & intermolecular forces weaken & ice becomes water.



2. Metals are molten in order to make machines .

Answer: Molten metals are easily shaped or mixed into alloys.

3. Cooking pots are made of stainless steel alloy.



Answer: Aluminum & stainless steel have high melting points.

Stainless steel doesn't rust when water is heated to cook food.

✓ *Vaporization & boiling points:*

Vaporization is the change of liquid into gas**.**

The boiling point is the temperature at which a substance starts to change from liquid into gaseous state.



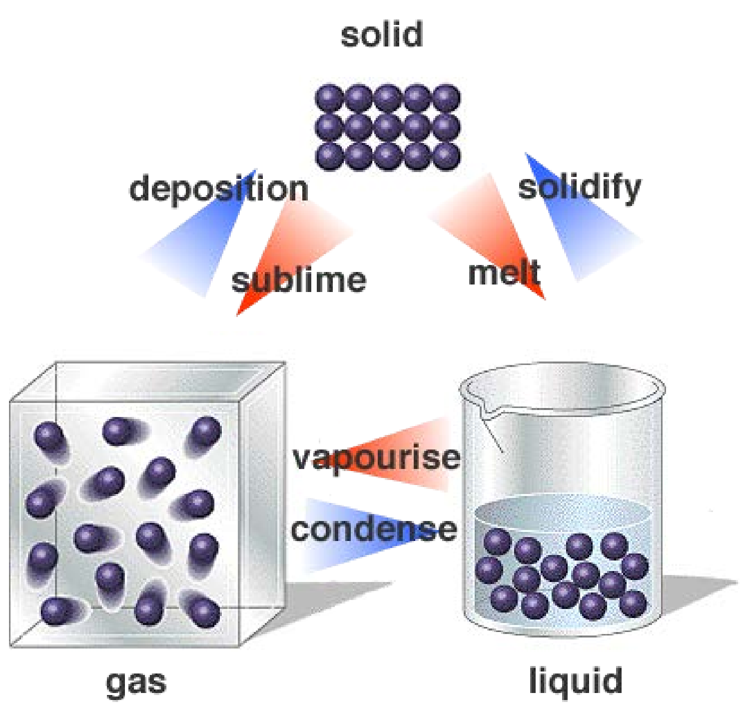
- Different substances have different boiling points.
- The boiling point of water is 100°C

✓ *Give Reasons for the following:*

Water evaporates (changes into vapour) when heated.

Water molecules gain energy by heating. Intermolecular spaces increase & intermolecular forces decrease.

Changes of states of matter by heating or cooling



✓ *The difference between atoms & molecules*

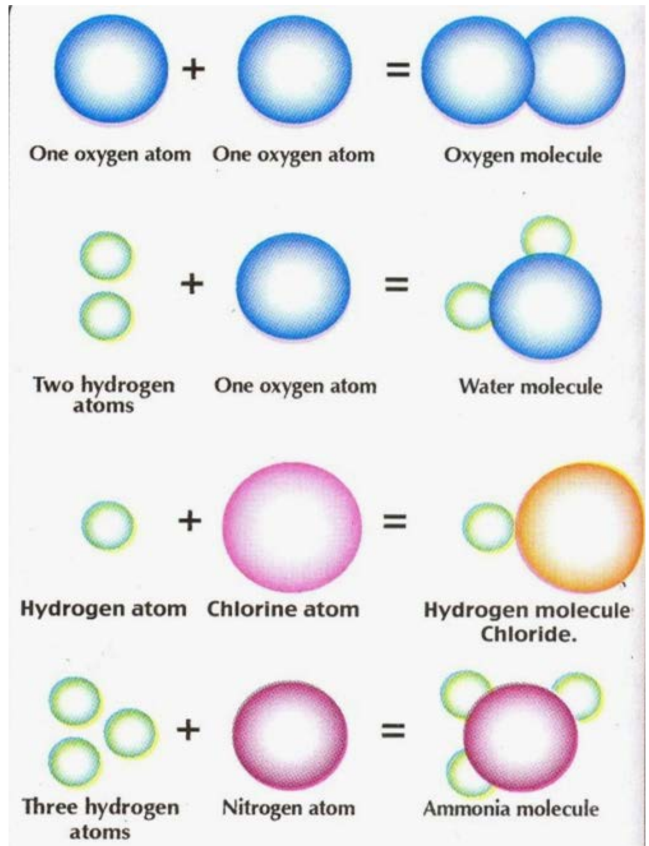
1- The building units of any matter are the **molecule**.

2- A **molecule** of matter can exist freely & has the properties of the substance.

3-The **molecule** consists of two or more atoms joined in a definite ratio.

4- The following figure shows some molecules & their structure.

- ✓ An oxygen molecule consists of two oxygen atoms.
- ✓ A hydrogen molecule consists of two hydrogen atoms.
- ✓ A water molecule consists of 2 hydrogen atoms & one oxygen atom.
- ✓ Hydrogen chloride molecule consists of one hydrogen atom & one chlorine atom.
- ✓ Ammonia molecule consists of one nitrogen atom & three hydrogen atoms.



✓ *The element & compound:*

1- The **element** is the simplest form of matter that can't be separated into simpler substances by chemical means. Hydrogen , oxygen & nitrogen are elements.

2- The **compound** results from the combination between two or more elements in constant ratio. Water consists of hydrogen & oxygen therefore water is a compound.

3- From the previous figure , you can conclude that water , hydrogen chloride & ammonia are compounds because they consist of two elements combined together in certain ratio.

	Solids	Liquids	Gases
Monatomic (a molecule consists of one atom)	Magnesium Iron Aluminium Carbon	Mercury	Inert (noble) gases such as: helium , argon & neon
Diatomic (a molecule consists of 2 atoms)	——	Bromine Br_2	Oxygen O_2 Hydrogen H_2 Nitrogen N_2 Chlorine Cl_2 Fluorine F_2

✓ *Elements exist in 3 states:*



Carbon is solid at room temperature



Mercury is liquid at room temperature



Bromine is liquid at room temperature

Summary & important definitions

1. The atom is the smallest unit of matter which undergoes chemical reactions.
2. Atoms combine together forming molecules.
3. Molecules are the building units of matter, they can exist freely.
4. The atoms of an element are similar.
5. Oxygen, hydrogen, iron & sodium are examples of elements.

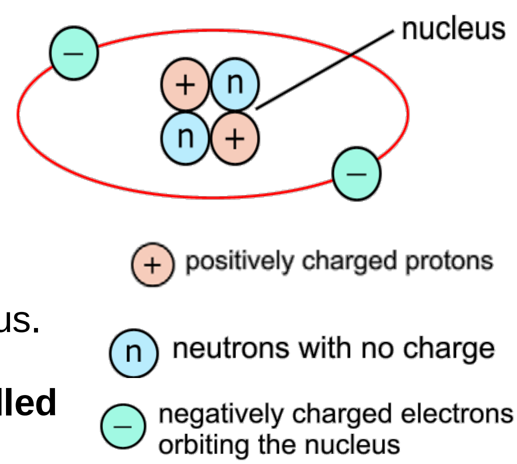
6. Elements combine forming compounds.
7. Water is a compound .Each molecule contains two hydrogen atoms & one oxygen atom.
8. Water , hydrogen chloride & ammonia are other examples of compounds.
9. Some molecules are made of two atoms such as oxygen , hydrogen & nitrogen.
10. The building blocks of metals such as iron , magnesium & gold are atoms.
11. Matter exists in three states : solid, liquid & gas.
12. Ice is solid water while water vapour is water in the gaseous state.
13. Intermolecular spaces are spaces between molecules.
14. Intermolecular forces keep molecules of a substance together.
15. In the solid state molecules are compact with small intermolecular spaces.The forces which keep them together are strong.
16. In liquids, Intermolecular spaces are bigger while forces between molecules are weaker than those in solids.
17. In gases, intermolecular forces are very weak that's why molecules move freely& the spaces between them are larger than liquids.
18. Heat overcomes intermolecular forces & a solid changes to a liquid then into gas.
19. The change of the state from solid to liquid is **melting**.
20. The temperature at which a solid state starts melting is the **melting point**.
21. The change of the state from liquid to gas is **vaporization**.
22. The temperature at which a liquid starts changing into gas is called **boiling point**.
23. Melting point & boiling point are physical characteristics for each substance.
24. The melting point of water is 0 °C.
25. The boiling point of water is 100°C.

Lesson 3: Atomic Structure of Matter

1. Chemists use symbols to express elements.
2. The symbol is a capital letter, if the symbol consists of 2 letters only the first one is a capital letter.

Element	*Symbol*	*Element*	*Symbol*
Lithium	Li	**Hydrogen**	H
Potassium	K	**Oxygen**	O
Sodium	Na	**Nitrogen**	N
Calcium	Ca	**Fluorine**	F
Magnesium	Mg	**Chlorine**	Cl
Aluminium	Al	**Bromine**	Br
Zinc	Zn	**Iodine**	I
Iron	Fe	**Helium**	He
Lead	Pb	**Argon**	Ar
Copper	Cu	**Sulphur**	S
Mercury	Hg	**Phosphorous**	P
Silver	Ag	**Carbon**	C
Gold	Au	**Silicon**	Si

✓ *The structure of the atom*



- Atoms are so small therefore they aren't seen by the naked eye. A drop of water contains millions of atoms.
- The atoms consists of the following:
- The center of the atom is a dense part called the nucleus.
- **The nucleus contains two types of tiny particles called protons & neutrons.**

- The nucleus is surrounded by negatively charged particles called **electrons.**

✓ *Comparisons:*

The nucleus	*The electrons*
1. The central part of the atom. 2. It consists of protons & neutrons. 3. It carries positive charge. 4. It has most of the mass of the atom.	1. They revolve in orbits around the nucleus. 2. Their charge is negative 3. Their masses are small (negligible)

Protons	*Neutrons*
1. Positively charged	1. Neutral (carry no charge)
2. Exist in the nucleus	
3. The mass of a proton almost equals that of a neutron, together protons & neutrons contain most of the mass of the atom.	

✓ *The atomic number & mass number*

- The number of protons in the atom of each element is unique & characterizes the element. Oxygen always has 8 protons while nitrogen has 7 protons everywhere in the world.
- **The atomic number is the number of protons in an atom.**
- **The mass number is the sum of protons & neutrons in an atom.**

Examples:

Mass no ^{16} O
Atomic no. $_{8}$
no. of protons = 8
no. of neutrons = 16 – 8 = 8

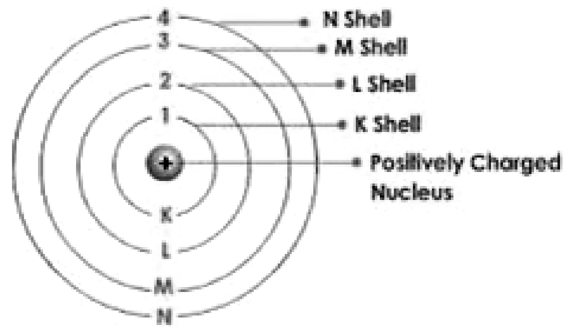
Mass no ^{14} N
Atomic no. $_{7}$
no. of protons = 7
no. of neutrons = 14 – 7 = 7

✓ *Give Reasons for the following:*

1. The atom is electrically neutral.

Answer: That’s because the number of positively charged protons = the number of negatively charged electrons.

✓ *Energy levels:*



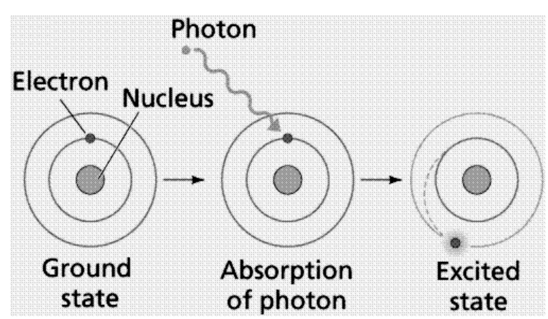
Electrons revolve around the nucleus in orbits called energy levels.

- Energy levels are places around the nucleus where electrons exist.
- There are 7 energy levels represented from the nearest to the nucleus to the farthest by the letters K, L, M, N, O , P, Q .
- The energy of the level increases by increasing the distance from the nucleus.
- Each level is saturated (completely filled) with a certain number of electrons.
- The number of electrons which saturate energy levels 1-4 is calculated by the rule **$2n^2$** . n is the number of the energy level.

no. of energy level	*Symbol*	*no. of electrons that fill the level*
1	**K**	$2 (1)^2 = 2$
2	**L**	$2 (2)^2 = 8$
3	**M**	$2 (3)^2 = 18$
4	**N**	$2 (4)^2 = 32$
5	**O**	The equation isn't applied because the atom will be unstable.
6	**P**	
7	**Q**	

✓ Quanatum

- When an electron gains a **quantum of energy**, it moves to a higher energy level. The atom is excited by gaining energy.
- The excited atom loses the quantum of energy electrons & return to the original level (**ground state**)



✓ Filling energy levels with electrons (electron configuration):

	Electron configuration
$^{2}_{1}H$	1+ 1± ; K: 1
$^{4}_{2}He$	2+ 2± ; K: 2
$^{7}_{3}Li$	3+ 4± ; K: 2, L: 1
$^{14}_{7}N$	7+ 7± ; K: 2, L: 5
$^{23}_{11}Na$	11+ 12± ; K: 2, L: 8, M: 1

✓ Why do substances react together?



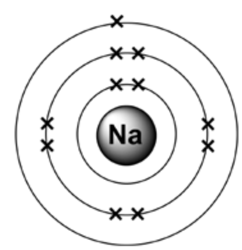
Sodium reacts with water

a. Substances react together producing new substances.
The activity which changes the substance into a new material is called chemical reaction.

b. An atom is the unit of the substance which undergoes a chemical reaction.

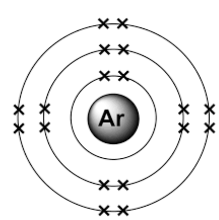
c. An atom that has less than 8 electrons in the last energy level is chemically active. It reacts with other atoms to complete the last energy level with 8 electrons.

An example: Sodium is active because the atom has an electron in the last energy level. In a chemical reaction sodium gives this electron to another element & ends up with 8 electrons in the last energy level.



Active

d. Inert gases such as Argon $_{18}Ar$ have 8 electrons in the last energy level therefore they are stable & don't react with other substances.



Inert

Summary & important definitions

1. Elements are expressed by symbols. For example the symbol of carbon is C while the symbol of calcium is Ca.
2. The atom consists of a nucleus surrounded by electrons.
3. The nucleus consists of positively charged protons & neutral neutrons. Electrons carry a negative charge & revolve around the nucleus in specific energy levels.
4. Protons are positively charged particles in the nucleus.
5. Neutrons are the particles in the nucleus that have no electric charge.
6. Electrons are particles present in the atom & they have negative charge.
7. The total charge of the atom is zero & the atom is neutral.
8. The mass of electrons is small , therefore the mass of the atom is the mass of the protons & neutrons.
9. The mass number is the no. of protons + no. of neutrons.
10. Each element has a unique atomic number which is the number of protons or electrons in a neutral atom.
11. Energy levels are regions inside the atom where electrons are found.
12. The number of electrons which completely fill energy levels 1 till 4 is calculated by the rule $2n^2$ where n is the number of the energy level.
13. The atom gains a certain amount of energy called quantum of energy & becomes excited.
14. An excited atom loses a quantum of energy & electrons return to the ground level.
15. An atom that has less than 8 electrons in its last energy level is chemically active.
16. Inert gases such as Neon ($_{10}Ne$) have 8 electrons in the last energy level except $_2He$ which has 2 electrons in the K energy level.

Unit 2
Energy

Lesson 1 :

Resources & Forms of Energy

Lesson 2:

Energy Transformation

Lesson 3:

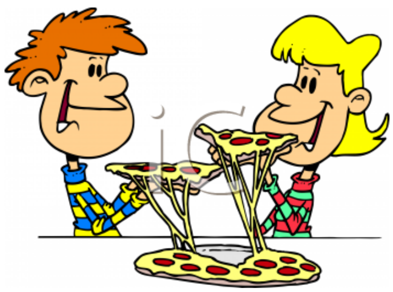
Heat Energy



Resources & Forms of Energy

✓ *What is energy?*

1. **Energy is the ability to do work or make a change**.
2. Fuel is burnt in the car to produce energy which moves the car.
3. Food is the living organism's fuel. The body burns food to get energy for vital activities.
4. A body which moves has **kinetic energy**.
5. When you lift a book into a high shelf, your energy is stored in the book. Stored energy is **potential energy**.
   When the book falls down, its potential energy is converted into kinetic energy.





✓ *Potential energy*

✓ *Definition:* **Energy stored in an object due to work done.**

✓ *Factors which affect potential energy*

Potential energy depends on the object's weight and height.

Potential energy = weight x height

A solved problem:

A ball which has a weight of 1 Newton is placed on a shelf 1m high.
Another ball whose weight is 1 Newton is placed on a shelf 2m high.
Which ball has the highest potential energy?

Solution:

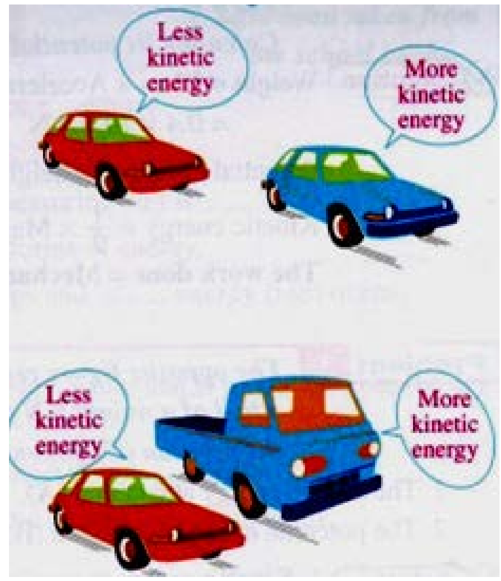
Potential energy (object1) = 1 Newton x 1 m = 1 Joule
Potential energy (object 2) = 1 Newton x 2 = 2 Joules
Potential energy of the 2nd object is double the potential energy of the 1st object.

✓ *Kinetic energy*

- ✓ **Definition: Kinetic energy is energy due to motion.**
- ✓ *Factors which affect kinetic energy*

Kinetic energy is affected by the mass or the speed of the moving object .
Calculate kinetic energy using the following rule:

Kinetic energy = ½ x mass x $(speed)^2$



A solved example:

Calculate the kinetic energy of a ball whose mass is 0.5 kg & moves with a speed 3 m/s.

Solution:

Kinetic energy = ½ x 0.5 x $(3)^2$ = 2.25 Joules

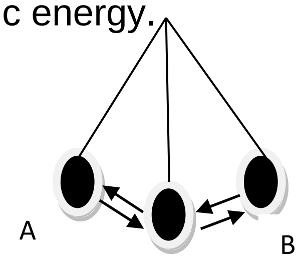
Definitions:

1. **Energy is the ability to do work or make a change**.
2. **Kinetic energy is energy due to motion.**
3. **Potential energy is the energy stored in an object due to work done.**

✓ *Mechanical energy*

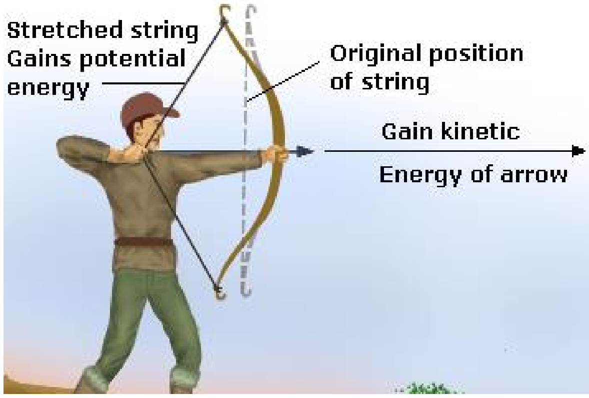
- ✓ *Definition: It is the sum of kinetic energy & potential energy.*
- ✓ *To explain the concept of mechanical energy , let's study the motion of the pendulum.*

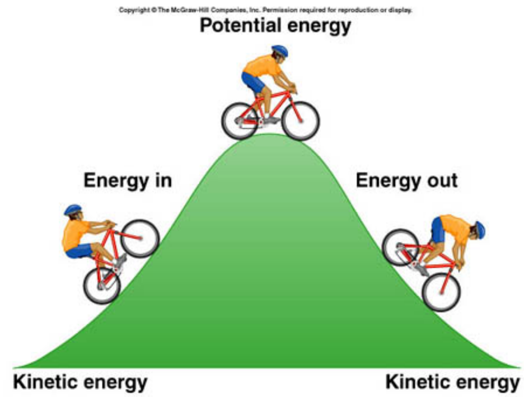
A pendulum is a ball tied with a string & fixed at a point. When the ball is pushed, it moves to the right then back to the beginning point, then to the left.
At points A&B , the potential energy of the pendulum is maximum.
As it moves away from point A, potential energy is changed to kinetic energy.
The mechanical energy of the pendulum is the same at each point.



The law of conservation of mechanical energy:

The sum of the kinetic energy & potential energy is constant under the effect of gravity.





✓ *Calculating the mechanical energy:*

A ball is thrown upwards with a speed 3m/s up to 4m. If the mass of the ball is 0.5kg & its weight is 5 Newton , what is mechanical energy of this ball?

Solution:

K .E. = ½ mv^2

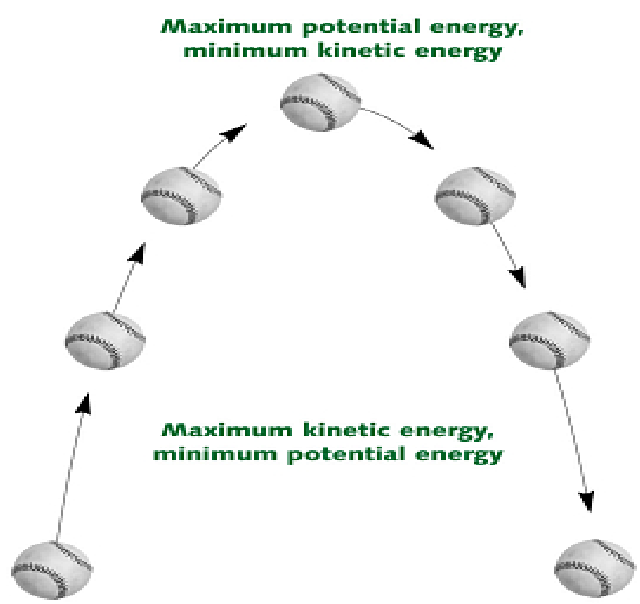
= ½ x 0.5 x $(3)^2$ = 2.25 joule

P. E. = 5 X 2 = 20 joule

Mechanical energy = K. E + P.E = 2.25 + 20 = 22.25 joule



Mechanical energy of the ball = potential energy only because its kinetic energy = 0



Summary & important definitions

1. Energy is the ability to do work or make a change.

2. Food gives living organisms energy to do vital activities.

3. Fuel provides machines with energy to move.

4. **Kinetic energy** depends on mass & speed.

5. **Potential energy** is the work done on the object to lift it to a certain height

6. **Kinetic energy** is the energy of an object due to the object's motion.

7. **Potential energy** that an object has depends on its weight & its height.

8. **Mechanical energy** is the amount of the work an object can do because of the object's kinetic & potential energy.

10. Kinetic energy = 1/2 x mass x (speed)^2.

11. Potential energy = weight x height.

12. Weight = mass x acceleration due to gravity.

13. Mechanical energy = kinetic energy + potential energy.

14. **The unit** of kinetic energy, potential energy & mechanical energy is **Joule**.

15. **The law of conservation of mechanical energy states that:**

The sum of the kinetic energy & potential energy is constant under the effect of gravity.

Lesson 2: Transformation of Energy

Energy has many forms such as light, sound, electricity, chemical energy , heat, nuclear, kinetic & potential energy.

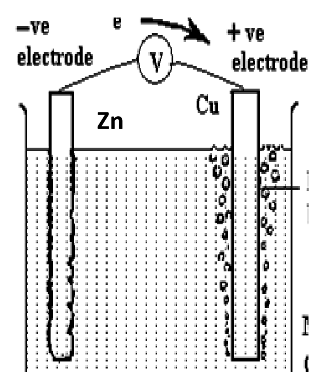
Forms of energy	Source
9. Light	Sun
10. Sound	Bell – Piano
11. Chemical	Fuel – Battery – Food
12. Heat	Heater
13. Kinetic	A moving car – wind
14. Potential	Stretched bow
15. Electric	Produced by an electric generator
16. Nuclear	Released by a nuclear bomb



Nuclear bomb

Activity 1: Simple cell

1. In a glass beaker, put 2 metal plates (zinc & copper)separately.
2. Fill half the beaker with diluted acid.
3. Connect the 2 plates externally with an electric current.
4. Put an ammeter in the circuit to measure the electric current.

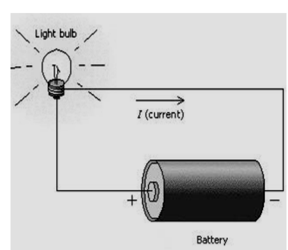


Observation : The pointer of the voltammeter moves to indicate the electric current is passing through the circuit.

Conclusion: The simple cell transforms chemical energy into electric energy.

Activity 2:

Prepare an electric circuit like the one in the figure, close the circuit then open the circuit using the switch.



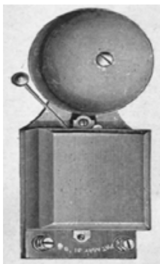
Observation :

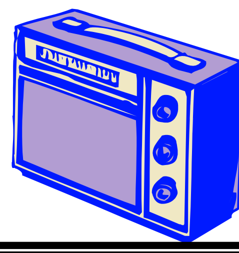
The bulb lights up when the circuit is closed. When the circuit is open & electricity isn't passing in the circuit, the bulb isn't lit.

Conclusion: In the electric bulb (lamp) electric energy is converted into light.

✓ *Energy is transformed from a form to another as in the following table:*

Device	*Energy used*	*Energy produced*
Electric bell	Electric	Sound
Burning fuel in a car	Chemical	Mechanical & heat
Electric generator (dynamo)	Mechanical(kinetic)	Electric
Radio	Electric	Sound
Electric heater	Electric	Heat







Law of conservation of energy

Energy is neither created nor destroyed, but It's changed from one form to another.

✓ *The negative effects that technology have on the environment:*

Modern technology (devices & machines) has much harm as follows:

Technology	*Harms*
Transportation vehicles	Their exhaust pollutes the air. Breathing polluted air harms humans' health .
Chemical pesticides	They are sprayed to kill harmful insects but harm useful ones as well. They also pollute the air.
Nuclear weapons used in war.	a. Spread harmful radiations that harm humans' health. b. Kill a large number of humans.
Cell phone transmission towers.	Their effect on health is being studied .

Nuclear bomb explosion



Cell phone transmission tower



Summary & important definitions

1. Energy has many forms such as light, sound, electricity, chemical energy, heat, nuclear, kinetic & potential energy.
2. Energy is transformed from one form to another in different devices.
3. The simple cell & batteries used at home convert chemical energy into electric energy.
4. In the car engine, the chemical energy stored in the fuel is changed into mechanical & thermal energy.
5. In the electric lamp, electric energy is changed into light energy.
6. The dynamo (generator) changes mechanical energy into electric energy.
7. **Law of conversation of energy:**

   Energy is neither created nor destroyed but it's converted from one form to another.
8. The harmful (negative) effects of technology are:

   a- Depleting (over consuming) energy resources.

   b- Polluting natural resources.

   c- Wars & killing huge number of people.

Lesson 3: Heat Energy

✓ ***The following observations will help you understand what is heat & how it is transferred.***



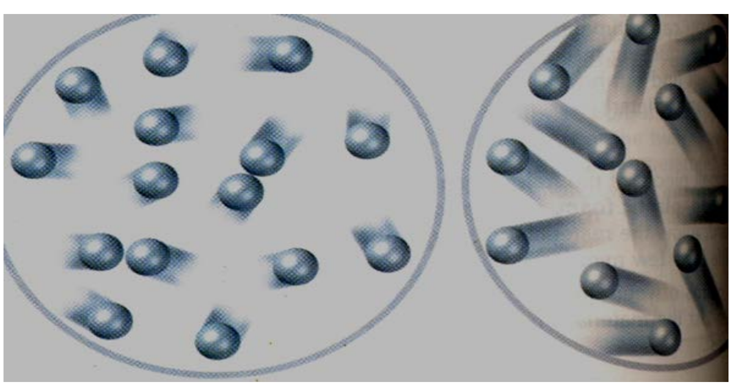
1. Ice cubes placed in a glass of juice melt & the juice is cooled because heat is transferred from the warm juice to cold ice.
2. When you rub your hands together they become hot.
3. When the cyclist pushes the brakes to stop the bicycle, the brakes rub against the wheels & they become hot, therefore friction produces heat energy.

Conclusion

- **Heat energy is the energy transferred from an object of higher temperature to an object of lower temperature.**
- **Friction generates heat.**



1. **Heat** is the energy transferred between objects that are at different temperatures.
2. **Temperature** is a measure of how hot (or cold) something is.
3. By rubbing your hands together, kinetic energy is converted into heat energy.
4. Friction changes mechanical energy into heat energy.
5. All matter is made of atoms or molecules that are always moving, therefore they have kinetic energy. The more kinetic energy the particles have, the higher the temperature of the object is.



The gas particles on the right have a higher kinetic energy than those on the left. So, the gas on the right is at a higher temperature.

✓ *How is heat transferred through different media ?*

1. **Through solid substances:**

Leave a metal spoon in a cup of hot tea. Touch the end of the spoon outside the cup. It feels hot because **heat was transferred in the spoon by conduction**.

2. **Through liquids & gases**

Put some tea dust in a beaker that contains water. Heat the beaker with Bunsen burner. Observe how tea dust moves up then falls down in circles.

Conclusion: when heated, the molecules of liquids move up & are replaced by cooler water, falling down. This way of heat transfer is called convection.

Heat is **transferred in liquids & gases by convection**.



The repeated rising and sinking of water during boiling are due to convection

3. **Through gases & space**

Heat is transferred from the Sun through space to the Earth by **radiation**.

Air conditioners are placed near the ceiling because cold air is denser than warmer air, therefore cold air moves downwards. Convection distributes cold air in the room.

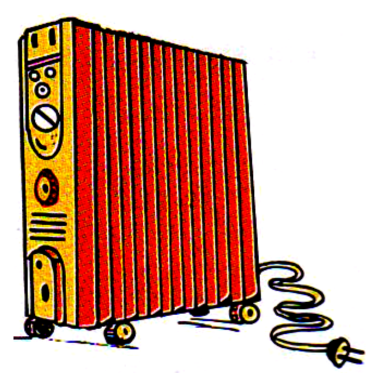


✓ *Give reasons for the following:*
Heaters are usually placed on the floor .

That is because the density of hot air is low, therefore hot air rises up. The heat is distributed in the room by convection.

Heat is transferred by 3 methods:

- ✓ *Conduction through solids.*
- ✓ *Convection through liquids & gases.*
- ✓ *Radiation through space & gases.*



- *Some domestic devices which produce heat are listed in the table:*

Device	*Energy used*	*Energy produced*	*Effect on the environment*
Gas heater & gas cooker	Chemical	Heat	They pollute the environment
Electric heater & cooker	Electric		They don't pollute the houses.
Solar heater	Solar		They don't pollute the environment.

- *Energy resources*

1. The origin of energy resources & forms on Earth is solar energy.
2. Some energy resources are forever (permanent) like the sun.
3. Fuel is not renewed when used, therefore it's non- renewable resource of energy.

Energy resources , their types & their effect on the environment are summarized in the following table.

Energy resources	*Type (permanent, or non – renewable)*	*Effect of their use on the environment.*
Solar energy	Permanent	Don't produce pollution
Fuel & nuclear energy	Non – renewable	Produce pollution



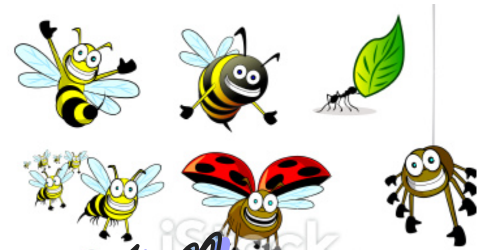
A cooker burns fuel (natural gas or butagas) to produce heat energy

Summary & important definitions

1. **Heat** is the energy transferred between objects that are at different temperatures.
2. **Temperature** is a measure of how hot (or cold) something is.
3. The more kinetic energy particles have, the higher the temperature of the object is.

4. By rubbing your hands together, kinetic energy is converted into heat energy.
5. Friction changes mechanical energy into heat energy.
6. **Thermal conduction** is the transfer of thermal energy from one substance to another through direct contact.
7. An example of conduction is putting a cold spoon in a cup of hot tea, soon the spoon warms up.
8. Substances that conduct thermal energy well are called thermal conductors. Metals are good thermal conductors.
9. Substances that don't conduct thermal energy well are called thermal insulators. Plastic & wood are thermal insulators.
10. Convection is the transfer of heat by the movement of a liquid or a gas.
11. **Radiation** is the transfer of energy as waves. Energy transfers by radiation between particles of gases or across empty space.
12. **Heat is transferred by three methods: Conduction, convection or radiation.**
13. Heaters which burn fuel such as natural gas pollute the environment by releasing harmful gases. They also consume non-renewable resources.
14. Nowadays solar heaters are preferred over gas heaters because solar heaters use clean energy & don't pollute the environment.
15. **An energy resource** is a natural resource that can be converted into other forms of energy to do useful work.
16. **Non renewable resources** such as fuels (petroleum oil & natural gas) are are consumed & can't be replaced. That's why they aren't permanent.
17. Fuels are burnt to generate electrical energy.
18. The High Dam in Aswan converts energy from water into electrical energy.
19. Some natural energy resources, such as solar energy are limitless that's why they are considered permanent resources.





Unit 3
Diversity & Adaptation in Living Organisms

Lesson 1:

Diversity of living organisms & their classification

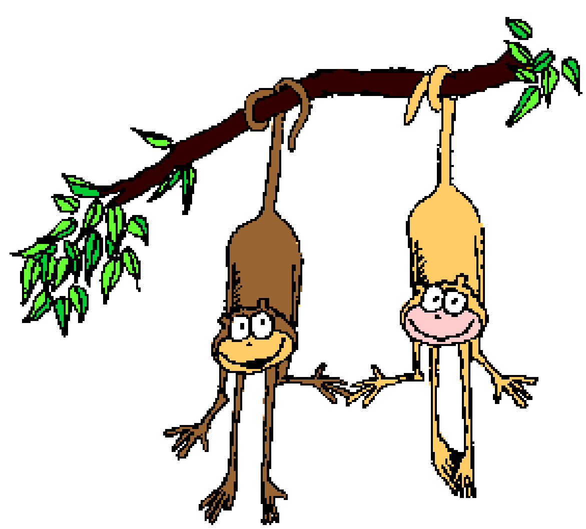




Lesson 2:

Adaptation and Diversity of Living Organism





Lesson 1: Diversity of living organisms & their classification

1. Living organisms are different. They are classified into groups in order to study & make use of them.
2. Living organisms –you will study this year – are classified into: microorganisms – plants – animals.



✓ *Microorganisms*

They exist in every environment. They're not seen by the naked eye & are only seen by a microscope.

Activity 1:

Aim : To examine some micro organisms through a microscope.

Materials : Some irrigation water from a potted plant - a dropper – glass slide – a plastic cover – some dye – a light microscope.



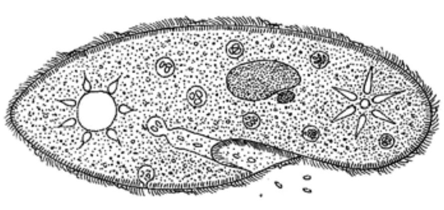
Procedure (steps of work)

1. Put a drop of water taken from a potted plant on a glass slide.
2. Add a drop of dye to the water on the slide.
3. Put the plastic cover on the water & examine the slide under the microscope.

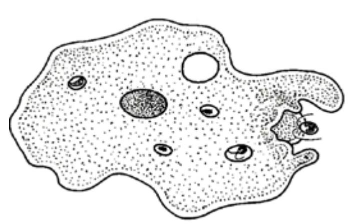
Observation :

1. Micro organisms of different shapes are seen moving in the slide.

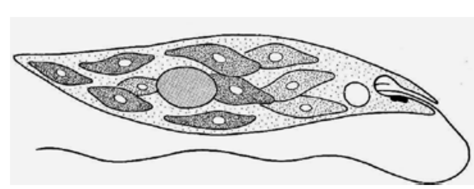
Microorganisms are unicellular organisms (the organism consists of one cell). Some examples are amoeba, euglena & paramecium.



Paramecium



Amoeba



Euglena

✓ *Plants:*

1. Plants like corn, wheat, palm & camphor have roots, stems & leaves.
2. Plant- like organisms called **algae** don’t have roots, stems or leaves. Brown & red algae are examples of algae. They form long threads which live in marine environment .

✓ *Classifying plants according to how they reproduce:*

- Plant reproduction is the production of new offspring .
- Plants either reproduce by spores or seeds.
- Ferns are plants which reproduce by spores.Spores are tiny structures which are dispersed by the plant. They fall in the surrounding environment & if the conditions around them are favorable , they grow into new plants.



Adiantum



Ferns

Plants which reproduce by seeds are classified into:

Gymnosperms

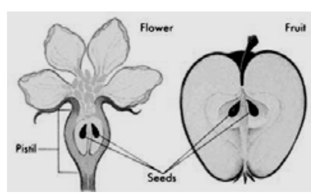
Plants which have naked seeds formed in the form of cones.

An example: pine



Angiosperms

Plants which have flowers where seeds enclosed by fruits are formed**.**



An example: apple trees

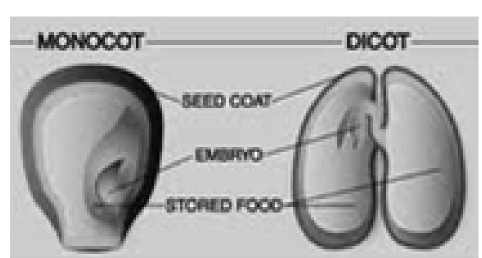
Monocotyledons

(mono cots) have one cotyledon

Dicotyledons

(dicots) have two cotyledons

Note: The cotyledon is a part within the seed , when the seed germinates , the cotyledon becomes the first leaves of the plant.



Plants which reproduce by spores	Plants which reproduce by seeds		
	Gymnosperms	Flowering plants Angiosperms	
		Monocots	Dicots
Ferns such as: Voughair & Adiantum	Pine Cycas	Maize Wheat	Bean Pea

Cycas



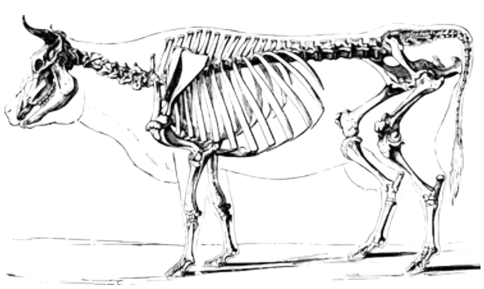
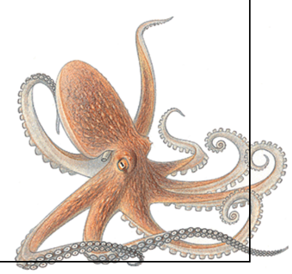


Monocot: Maize

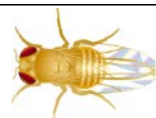
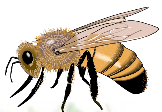


Dicot: Bean

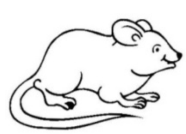
✓ *Classifying animals according to body support*

Internal skeleton & back bone (Vertebrates)	*Absence of internal support (Invertebrates)*	
	Supported body (external skeleton)	Soft body (without external support)
Fish Amphibians Bird Reptiles Mammals 	Snail  Mussel 	Jellyfish  Earthworm  Octopus 

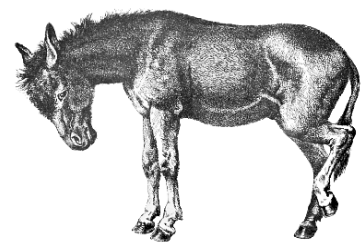
- ✓ *Arthopods are invertebrates which are characterized by jointed legs.*
- ✓ *Classifying arthropods according to the number of legs:*

Insects	Arachnids	Myriapods
They have **3 pairs** of jointed legs	They have **4 pairs** of jointed legs	They have **many pairs** of jointed legs
Fly  Honey-bee  Ant 	Spider  Scorpion 	Scolopendra  Julius 

- ✓ *Taxonomy is the science of classifying living organisms in groups according to similarities.*
- ✓ *Classifying mammals according to the number & type of teeth:*

<table>
<tr><th colspan="4">Animals with teeth</th><th>Animals without teeth (Edentates)</th></tr>
<tr><td rowspan="2">Animals with extended teeth</td><td rowspan="2">Animals with sharp canines</td><td colspan="2">Animals with sharp incisors</td><td rowspan="2"></td></tr>
<tr><td>Rodents have one pair of incisors in each jaw.</td><td>Lagomorphs have 2 pairs of incisors in the upper jaw and 1 pair in the lower jaw.</td></tr>
<tr><td>Hedgehog </td><td>Lion  Tiger </td><td>Rat  Squirrel </td><td>Rabbit </td><td>Sloth  Armadillo </td></tr>
</table>

- **All organisms with similar shape & are able to reproduce & give birth of fertile animals form a group called species**. **The species is the base of taxonomy.**
- An example: Horses (brown, white or black) are one species because they can mate (reproduce) & give birth to ponies that grow into horses & reproduce again thus the species doesn't become extinct. Donkeys are another species.
- When a female horse mates with a male donkey, it gives birth to a mule. The mule isn't fertile & can't reproduce.



Summary & important definitions

1- Living organisms are very diverse. Scientists classify living organisms by different methods in order to study them.

2- **Micro-organisms** are unicellular living organisms which are only seen by a microscope.

3- Amoeba, euglena & paramecium are different examples of micro-organisms. They differ in shape, the way they move & the environment they live in.

4- Algae are plant-like organisms which don't have roots, stems or leaves. They are classified into different types according to their colors, red, green & brown for example.

5- Plants reproduce by spores such as ferns.

6- **Gymnosperms** are plants which produce seeds inside cones. Their seeds don't have a pericap such as pine plants & cycas. The pericap is the fruit formed around the seed.

7- **Angiosperms** are flowering plants which produce seeds. They have two classes:

a- **monocotyledons** such as maize & wheat

b- **Dicotyledons** such as beans & pea plants.

8- Animals are classified into **invertebrates & vertebrates.**

9- Invertebrates are animals without internal support (vertebral column & skeleton)

10- Soft invertebrates have soft bodies such as jelly fish, octopus & worms.

11- Other invertebrates have external shells (support) such as mussels &snails.

12- Vertebrates have many classes such as fish, reptiles, birds, amphibians &mammals.

13- **Arthropods** are invertebrates with jointed legs. They are classified into 3 classes according to the number of legs & other body features.

a- **Insects** have 3 pairs of jointed legs Examples: locust, bee, fly, cock roach.

b- **Arachinds** have 4 pairs of jointed legs. Examples: the spider & scorpion.

c- **Myriapods** have large number of legs. Examples: scolopendra & Julius.

14- Edentats are teethless mammals such as the sloth & armadillo.

15- Some mammals have their front teeth extending outwards such as hedgehogs their teeth help them catch insects.

16- Lions & tigers have sharp canines to cut their preys.

17- Lagomorphs & rodents are two classes of mammals.

18- Lagomorphs such as rabbits in that differ from rodents such as rats & squirrels.

19- Lagomorphs have 2 pairs of incisors in the upper jaw while rodents only have one pair of incisors in their upper jaw.

20- **Taxonomy** is a field of biology which describes & classifies organisms based on their characteristics.

21- The species is the basic unit of classification it's a group of organisms capable of mating & producing fertile offspring.

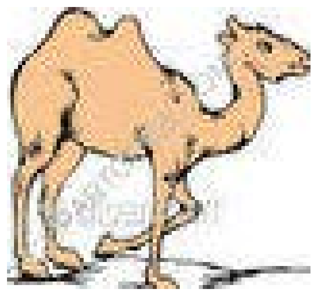


Lesson 2 : Adaptation and Diversity of Living Organisms

Living organisms live in different environments. With diverse conditions.

The desert is hot & it has sandy soil. Camels' feet are thick flat pads to walk on the sand. The mountain has rocky surface. Horses' hooves are hard to be able to walk on the rocks.









The modifications in living organisms to survive in the environment are called adaptation.

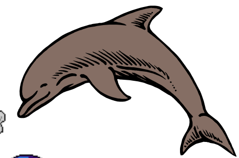
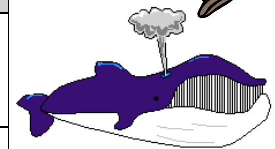
Adaptation has 3 types:

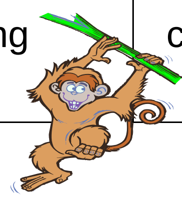
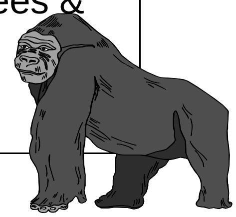
Modification of structure	*Modification of function*	*Modification of behavior*
❖ Camels have padded legs to walk on the sand ❖ The legs of horses end with hard hooves to walk on & climb rocky areas.	❖ Sweat is secreted in hot weather to cool the body. ❖ Snakes secrete poisons to capture their preys such as rats .	❖ Birds migrate to warm places in winter. ❖ Bats are active during night while other organisms (horses) are active during day.

✓ *Structural adaptation :*

1. *Living organisms have different limbs to move in their environments:*

Organism	*Adaptation of their limbs*	*Reason*
Whales & dolphins	Paddles (also called fins)	To swim in aquatic environments.
Bats	Wings	For flying
Horses	Strong legs	For running
Monkeys & gorillas	Their arms & fingers are long & strong	To climb trees & catch food.

2. *The beaks & legs of birds have different shapes according to the food they eat & the environment they live in.*

Organism	*Adaptation of the beaks & legs*	*Reason*
Predatory birds such as hawks & vultures 	-Sharp & crooked (curved) beaks.  -Their fingers end with sharp claws.	To tear the prey. To catch the prey.
1. Heron	-Long thin beaks -Long thin legs & fingers.	To pick worms in shallow water To walk in shallow water ponds (their environment).
2. Water birds such as ducks & geese	-Wide indented beaks . -Webbed feet (called palm)	To filter mosses from water. For swimming

Heron



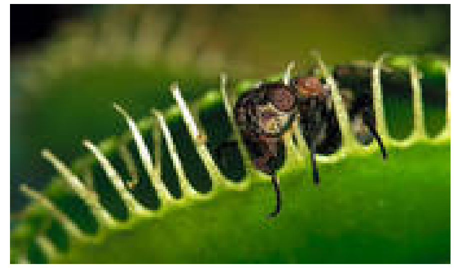


Duck

3.Adaptation of insectivorous plants (Insect- eating plants):

Drosera , dionea are predating plants.

They perform photosynthesis & make carbohydrates (their food) like all green plants. They also catch insects & digest them. The digested insects are the source of nitrogenous material (made from nitrogen). The insectivorous plants use nitrogenous material to make proteins needed to build their bodies.



Dionea

Summary & important definitions

1. **Adaptation** is the change in structure, function or behavior by which a species can survive in a specific environment.
2. Examples of adaptation

a- **Structural,** such as:

The hooves of the horse & the pads of the camel.

b- **Functional**, such as:

- Secretion of sweat in humans to cool the body during high temperature.

-Snakes secrete poison to kill their preys.

c- **Behavioral**, examples:

-Birds migrate in different seasons to reproduce in suitable weather.

-Some desert animals stay in burrows during the day & come out during night to avoid high temperature.

3. The limbs of mammals suit their environment :

-Whales & dolphins have paddles (fins) to swim in the sea & ocean.

-Horses run fast because their legs end with hard hooves.

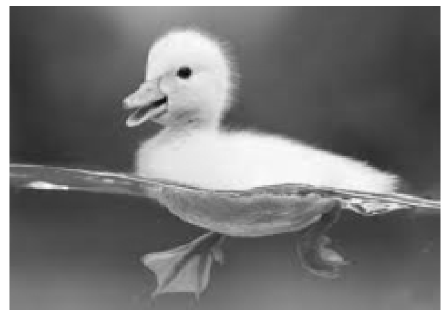
-Monkeys have long arms that help them climb & swing on trees find food.

4. The beaks & legs of birds are used to feed & survive in the environment as follows:
   - Predators such as hawks & vultures have sharp crooked beaks & sharp claws to catch & tear preys.

- Herons have long legs to wade in shallow lakes. They also have long beaks to feed on worms & snails that live in water.
- Water birds such as ducks & geese feed on mosses (small plants) &small fish. Their beaks are wide & indented to filter mosses from water. They also have padded feet to swim in water.

5. Drosera, dieonea & halophila are insectivorous plants. They produce carbohydrates during photosynthesis They feed on insects to absorb nitrogenous compounds & use them to build proteins.













Drosera



